Space Weather Technical Forecast

Issued on Saturday, 19 February 2022 at 12:55 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/Minor geomagnetic storm intervals Likely day 2 into day 3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with only B-class flares. There are currently three numbered sunspot regions on the visible disc. , with one unnumbered sunspot in the northeast quadrant. All sunspots are relatively simple and quite stable, with all other smaller spot regions now faded to plage. No Earth-directed Coronal Mass Ejections (CMEs) were evident in available coronagraph imagery in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was at background levels, around 320-380km/s. The solar wind density was generally around average or a little above average, with a peak at 20ppcc at 18/1453UTC. There was also a slight enhancement in ACE EPAM LEMS during the period, which may perhaps indicate a possible transient. The IMF has fluctuated between weak and moderate, peaking at 11nT during the UTC of Friday evening. The north-south component ranged between +8 and -8nT, while the phi angle was consistently negative (towards the sun) throughout. The net result of the above solar wind measures was Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES 16 has tracked slightly above background levels after an evidently very large and energetic flare and CME seen on coronagraph imagery from the rearward eastern solar hemisphere on 15 February. This peaked at 1.89pfu at 18/2120 UTC and has since declined back to below 1pfu. The high energy electron flux (greater than 2MeV) started High, with a diurnal peak of 4650pfu at 18/1530UTC, before gradually falling to background levels during the evening of 18th UTC. The corresponding 24-hour integrated electron fluence rose from Moderate to above the Active 1e8 levels between 18/1800-19/0600 UTC. 1.06e8 integrated pfu was recorded at 19/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low at first, given the sparsely populated Earth-facing disc, however there are indications that a large and potent region may rotate onto the facing side into the new working week. The magnitude of this increase will be assessed as and when the spot responsible becomes visible to analyse.

Solar Wind / Geomagnetic Activity: No earth directed CMEs feature in this forecast period. Solar winds should remain in a slow regime until the possible onset of coronal hole 55 and then 56 in succession late on day 2 or on day 3. Solar winds are expected to respond, becoming slightly elevated, or elevated, probably reaching 450-550 km/s as indicated by the solar wind persistence model. Geomagnetic activity is expected to be Quiet to Unsettled (Kp1-3) during day 1 (19th), becoming Active with Likely G1/minor storm intervals late on day 2 (20th), this probably continuing into day 3 (21st). Geomagnetic activity then becoming Quiet to Unsettled with a Chance of Active intervals by day 4 (22nd).

Energetic Particles / Solar Radiation: The high energy proton flux is expected to remain within

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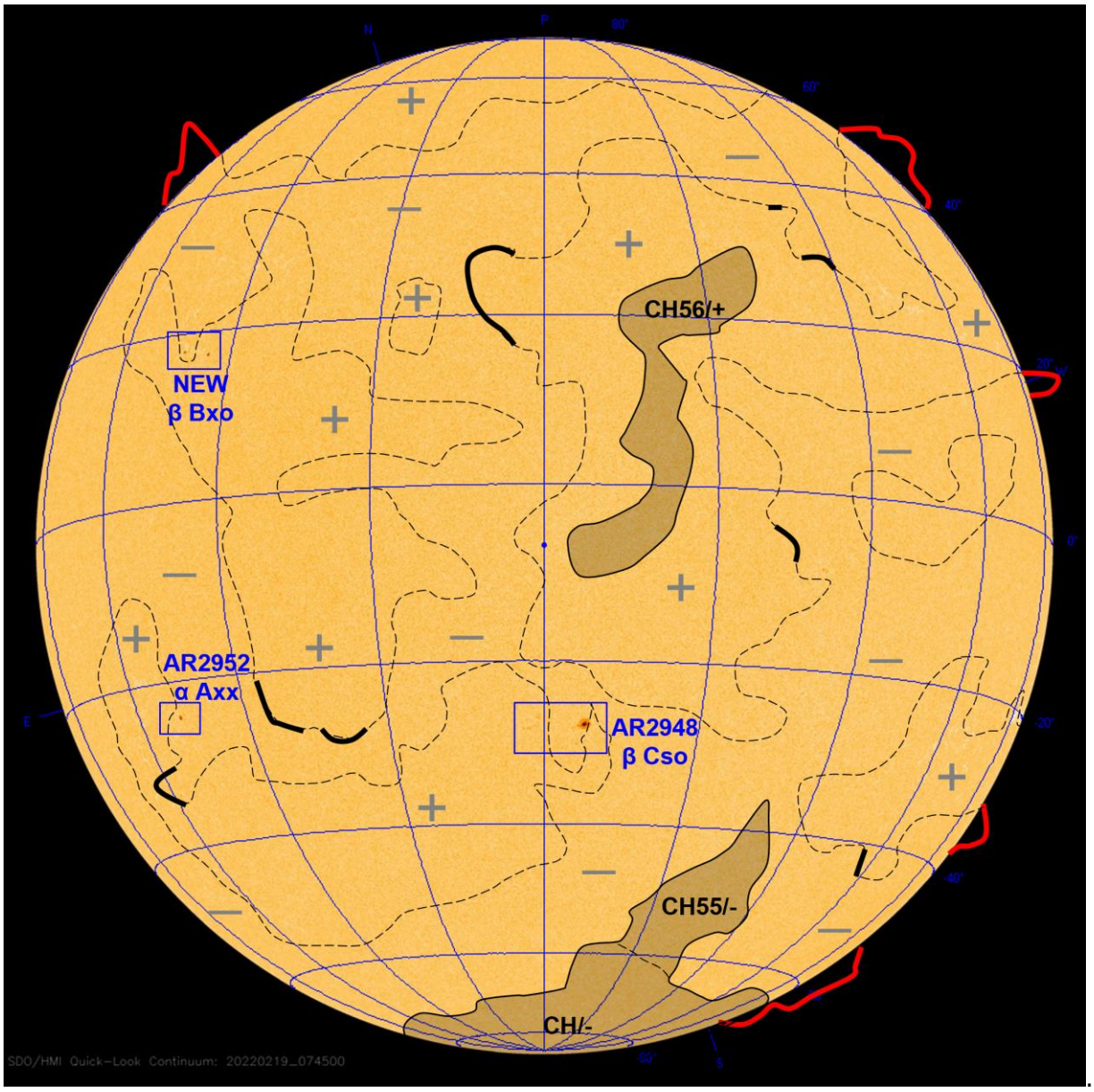
Background levels during the period, with the slightly disturbed 10MeV trace continuing to relax through the period. The high energy electron flux has now fallen back to background levels, with a slight chance it may reach moderate to high levels again later on day 1 (19th). With the onset of the coronal hole fast winds expected on Sunday 20th, flux levels are expected to become further suppressed from day 2 onward. The corresponding electron fluence has now fallen below the 1e8 active threshold and is expected to remain so for the rest of the forecast period.

Figure 1. Solar Analysis Valid 19/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

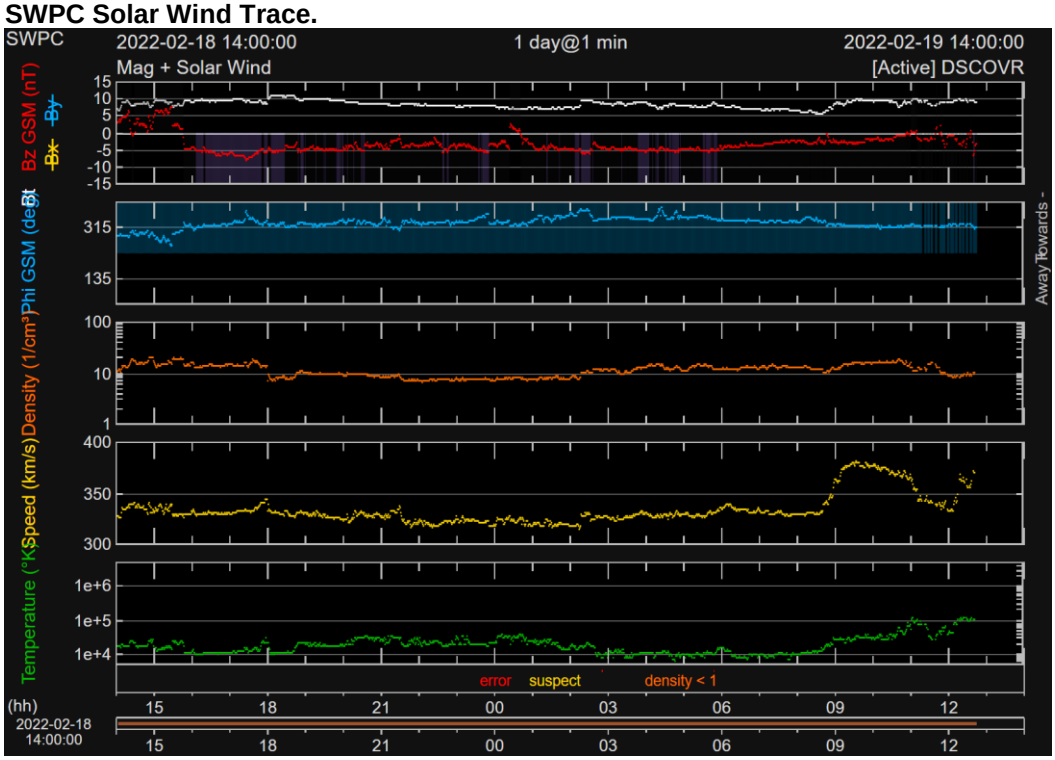
No Earth-directed CMEs feature in this forecast at present.

The current background level solar winds are expected to increase during Sunday 20th and into early next week, due to a high speed stream from a combination of coronal hole influences (CH56 and CH55). These are of opposing polarity, and any transition between them should be distinct. Of the pair, the earlier-arriving ought to be the more impactful, for being of more potent negative polarity and connected to the southern crown.

After around 24 hours, the phi angle may switch to positive, with effects from CH56/+ probably more muted, although this coronal hole combined with any belated activity from CH55/- should make a G1/minor storm Likely during day 2 (Sunday 20th February) with a Chance of it continuing into day 3 (Monday 21st February). Coronal hole influences begin to wane on day 4 (Tuesday 22nd February).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	60	40	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: SWPC Solar Wind Trace.



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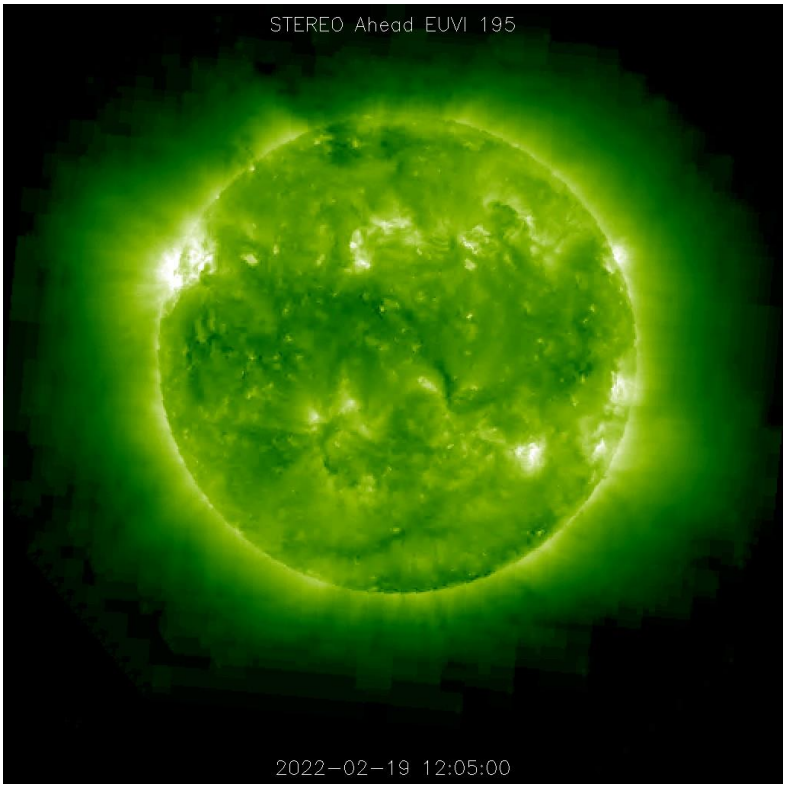
Radio Blackouts - X-Ray Flares:

The solar disc has continued to simplified in the past 24 hours, with the western solar hemisphere seeing all its spots fade, while those in the east remained relatively quiet and unremarkable.

The most significant event likely in the period is the possible return of the region of the sun responsible for the large rearward flare and CME on 15 February. The region responsible is just coming into view on STEREO A EUVI195 imagery, however any upward contribution it makes to the current Slight daily Chance of M-class flares will be assessed when it arrives over the limb. None of the remaining front side spots should leave the disc in the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Bright Region to the northeast on STEREO A EUVI195 imagery.



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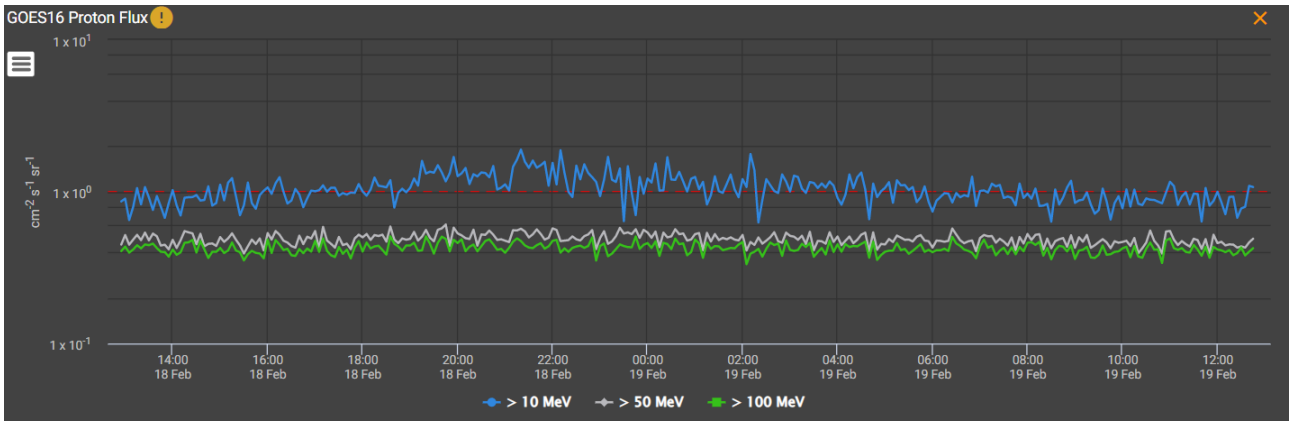
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 has tracked slightly above background levels since 18/1200UTC, but has now peaked and continues on a declining trend. The enhanced activity was due to a very large and energetic flare and CME seen on coronagraph imagery from the rearward eastern solar hemisphere on 15 February. This region has not produced noteworthy events since, and is moving further from being geoeffective, so while S1 enhancements are not expected, it provides indication of something to watch should it survive into the new week to return to the Earth-facing disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Past 24 hours of GOES16 Proton Flux



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High Energy Electrons Event (≥ 2MeV):

The high energy electron flux has fallen back to background levels since the evening of the 18th. This is likely due to the suppressing effects of a CME which passed close by earth. This has therefore altered the trend seen recently, with only a small chance that flux levels will become active during days 1 and 2. Flux levels will become further suppressed later on day 2 and into day 3 due to the onset of the HSS from coronal holes 55 and 56, after which we may see a response, but any rise likely outside of the coming four days. Fluence levels have also shown a decreasing trend in recent hours, falling just below the 1e8 Active threshold from 0900 on 19th. There remains a chance of diurnal variations in Flux having a knock-on effect on Fluence levels, mainly during days 1 and 2, though this probability has vastly reduced since the previous forecast.

Though REFM is below current observations, it likely provides a good steer for the overall gradual downward trend through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	30	30	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: Past 24 hours of GOES16 Electron Flux

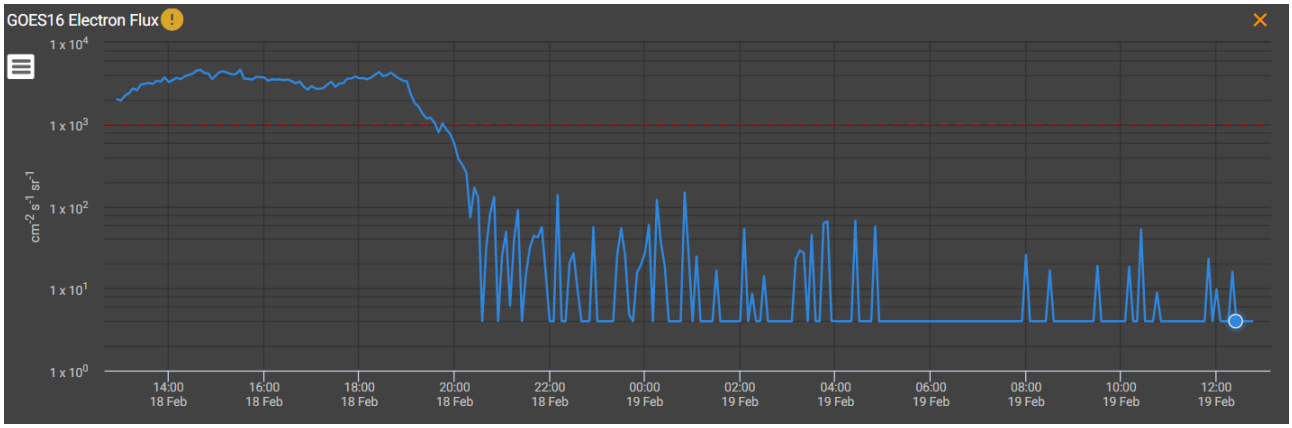
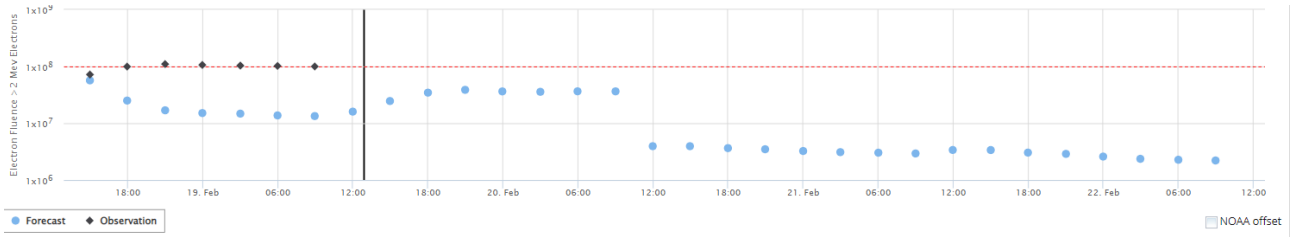


Figure 5: REFM Observed and Forecast Electron Fluence



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